ENGINEERING DATA

FOR

CAR EQUIPMENT MAINTENANCE

A. C. Roe
Renewal Parts Eng. Dept
9/25/24

PREPARED FOR Mr. Master Mechanic

OF

The Railroad Company

GENERAL ELECTRIC COMPANY

SCHENECTADY, N. Y.

MD-No 1
April 2-1924.

ENGINEERING DATA

FOR

CAR EQUIPMENT MAINTENANCE

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Air Brake and Safety Car Control Equipment	84550.1A
Better Commutation for Railway Motors	64400 A
Carbon Brushes for Railway Motors	64404
Caring for Direct-current Aluminum Car Arresters During the Winter	X 373
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Dated April 2-1924.

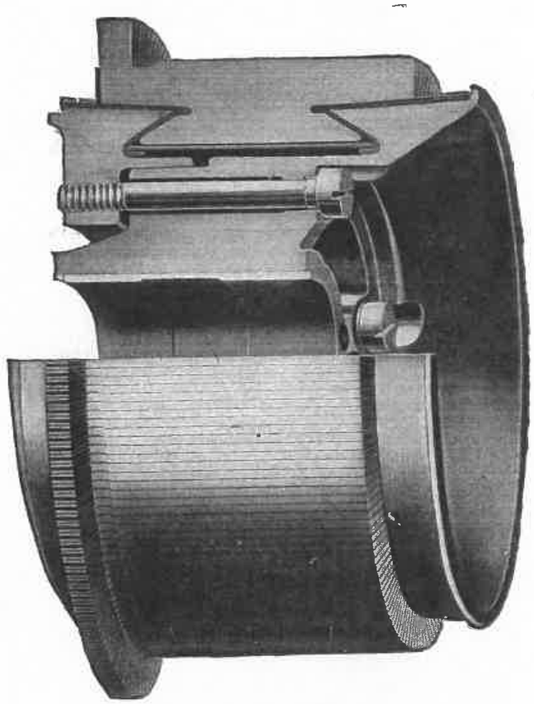
ENGINEERING DATA FOR CAR MAINTENANCE

The Railroad Company M.D.-1

TYPE OF CAR	EQUIPMENT			DIAGRAMS
	MOTOR	CONTROLLER	COMPRESSOR	
	GE-264-A	K-63-BR Governor ML-A1	CP-25-C2	Motor Wiring K-1629320 Car Wiring L-1634557 Resistor K-1637272 Compressor DS-39681 Air Piping P-705577
	GE-260-A	Master CJ-131-B Motor PC-101-F1	CP-28-D1	Motor Wiring None Car Wiring P-1636339 Resistor K-1637239 Compressor DS-15770 Air Piping
				Motor Wiring Car Wiring Resistor Compressor Air Piping
				Motor Wiring Car Wiring Resistor Compressor Air Piping
				Motor Wiring Car Wiring Resistor Compressor Air Piping
				Motor Wiring Car Wiring Resistor Compressor Air Piping
				Dated April 2-1924.

THE REPAIR OF RAILWAY MOTOR COMMUTATORS

G-E railway motor commutators are of either the *bolted* or *ring nut* construction. The bolted type usually has the cap at the back and the shell which presses on the shaft or spider in the front, the two members being held together by bolts. The ring nut type of commutator has the cap in front and the shell in back, the two members being held together by a ring nut threading on the shell which extends through to the front end of the commutator. The commutator ring nut is locked in place by a set screw. When it is necessary to repair either type, the process is very similar after the shell or cap, as the case may be, is removed.



Bolted Type Commutator

Replacement of Segments

Bolted Type Commutator

When replacing the copper segments in bolted type commutators, operations should proceed as follows: Remove thrust collar from shaft and draw a few turns of wire tightly around the commutator to prevent segments from separating during the removal of the shell which frequently entails more or less pounding and jarring. Remove the leads directly connected to the segments to be replaced; remove all of the bolts and pull out the shell; next remove the mica cone; then take off the wire band, drive forward and take out *one* of the segments to be replaced. A new segment should be made using the old one as a template. This should be cut from solid copper since commutator segments are not interchangeable and must be of the same bar gauge or taper as the old segment. Place the two segments together with the bottom edges or thin side even, then lay out and form the new segment from the old one, taking care that the 30 degree and 3 degree angles are exact. Insert new side mica and place the new segment in the commutator. If necessary to replace several segments, proceed, *one segment at a time*, as described above. The mica cone, if not damaged while being removed, should be put back. If it is damaged, insert a new cone. Then press the shell back on the shaft until it is approximately one inch from its original position. Insert the bolts and take them up all around a little at a time to insure that the cap at the back of the commutator is drawn up evenly as the shell is being pressed home. The commutator should next be heated with a gas ring to approximately 115 degrees centigrade and the bolts tightened while it is still hot. It is highly important that the segments be clamped as tightly as possible so they will not loosen in service —test for this by tapping them with a light hammer. After cooling, turn the face of the commutator and regroove if necessary.

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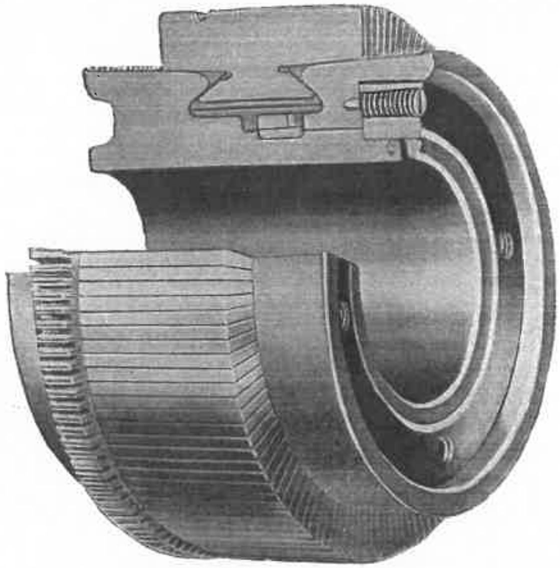


Ring Nut Type Commutator

Replacement of Segments

Ring Nut Type Commutator

In order to replace the segments on a commutator of the ring nut type, remove the thrust collar, band some wire around the segments, and disconnect the coil leads from the segments to be replaced. Take out the set screw and unscrew the commutator nut. Remove the cap and mica cone. Next replace the copper segments as described in the preceding paragraph; reassemble the mica cone and cap; and thread in the nut as far as possible while the commutator is cold. Heat the commutator as described above and tighten the ring nut. Turn the face and regroove if necessary.

Turning the Commutator

Before turning a commutator, a suitable head covering should be made to prevent chips or dust from working into the armature. This is best accomplished as follows: Take a strip of cotton several inches wider than the length of the end connections and long enough to encircle the commutator; wrap it around the commutator, binding the inside edge with cord as closely to the end connections as possible; then turn the cloth up over the latter and bind with cord to the outside of the armature. Make sure that the turning post is so set that the ways are absolutely parallel to the commutator and are securely fastened and braced. Use a side-cutting tool with point ground to about a $\frac{1}{16}$-in. radius. The cutting side and point should be given considerably more rake than is customary for working iron or steel. The tool must be sharp enough to make a clean, smooth cut without dragging copper over the mica.

While turning, the commutator surface should be run at a speed of approximately 300 feet per minute. This is about as fast as a tool will cut without burning. It is important to round off the ends of the copper segments to at least a $\frac{1}{16}$-in. radius with a file while the commutator is in the lathe. If this is not done and sharp corners are left at the ends of the copper segments, the mica is easily broken out and a short circuit may be established by oil and dust at these points.

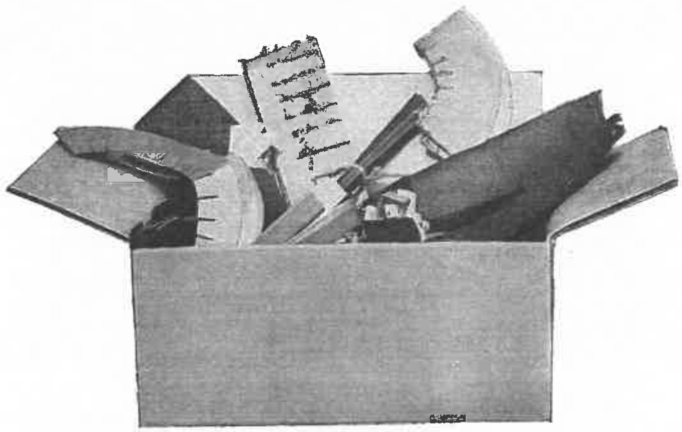
Commutator Hand Scraper

Grooving the Commutator

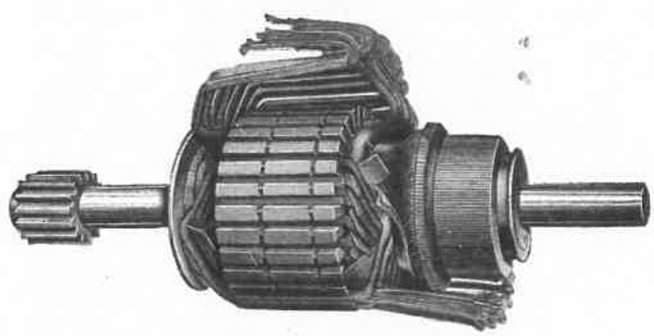
After turning the commutator, the side mica should be grooved to a depth of approximately $\frac{3}{64}$ of an inch. Refer to G-E Railway Supplies Catalog No. 6002, pages 303 and 304, for commutator grooving machines, to Descriptive Sheet No. 64407.

The finishing of the slots left by the grooving saw is an important operation because good commutation and brush wear depend very much upon the condition in which the commutator goes into service. The hand scraper, Cat. No. 775854G1, illustrated above is used for removing mica fins which are left in the slot by the grooving saw. The grooving saw is usually 0.005 of an inch less in thickness than the mica between the commutator segments. The grooving saw generally cuts into the copper and leaves projections which must be removed. A curved triangular file is sometimes used for removing these copper projections, but the removal of a very thin portion of the commutator surface by turning in a lathe is recommended. For this final turning, a special high speed steel tool (trade name No. 3 Stellite) will give good results. The remaining copper burr which projects into the slot on the trailing edge of each commutator segment can be removed by the hand scraper above illustrated. Final polishing with sandpaper will make the smooth surface necessary for good commutation and long brush life.

Railway Motor Armature Insulations



Insulations are carefully packed in individual cartons containing the exact quantity of cut materials and clips necessary for winding one particular armature. They can be stocked without appreciable deterioration and are at all times ready for the winder's use.



Railway Motor Armature, Partially Wound

Advantages of Ready-To-Use Insulations

1. All necessary pieces on hand
2. Cut to fit the particular armature
3. Prevent omission of essential parts
4. Save time in winding
5. No waste of materials
6. More economical than bulk insulation
7. Permit a factory job in the repair shop
8. Insure fewer renewals and better operation
9. Maintain original equipment quality

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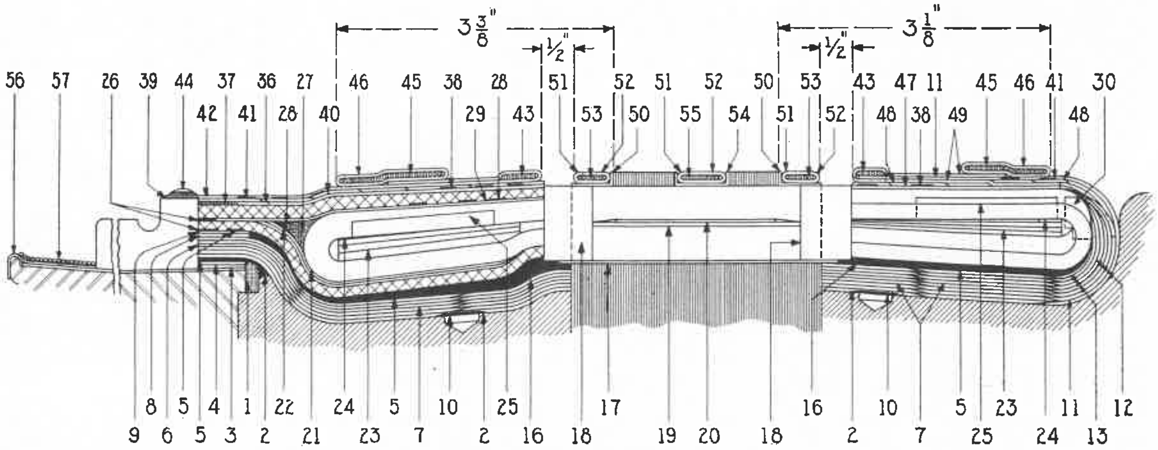
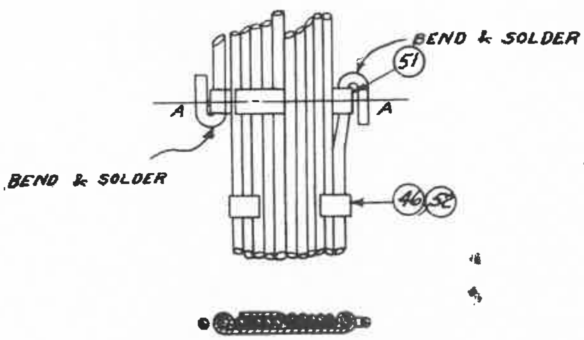
Insulation Data for Typical Railway Motor—Type GE-265



Sectional Elevation



SECTION A-A

METHOD OF SECURING BINDING BANDS

*CORE DRESSING -			
Part No.	Quant.	Material	Application
1	1	Boot Cord No. 7, 25 ft. 0"	Filler Between Arm. Hd. and Comm.
2	3	Acme Tape .012" X 3/4" X 12 ft. 0"	Binder Over Parts Nos. 1 and 10
3	1	Untreated Horn Fibre	Strip Over Comm. Shell
4	2	Varnished Canvas	Strip Over Comm. Shell
5	6	Acme Tape .012" X 3/4" X 18 ft. 0"	Binder Over Parts Nos. 4, 6, 7, 8, 12 and 13
6	6	Varnished Cloth	Insulation (Comm. End)
7	2	Varnished Cloth	Insulation (Pin. and Comm. End)
8	1	Varnished Cloth	Strip Over Comm. Shell
9	1	Horn Fibre	Strip Over Comm. Shell
10	2	Horn Fibre	Strip Over Balance Holes
11	1	Cotton Drill	Hood (Pinion End)
12	3	Varnished Cloth	Insulation (Pinion End)
13	3	Varnished Cloth	Insulation (Pinion End)

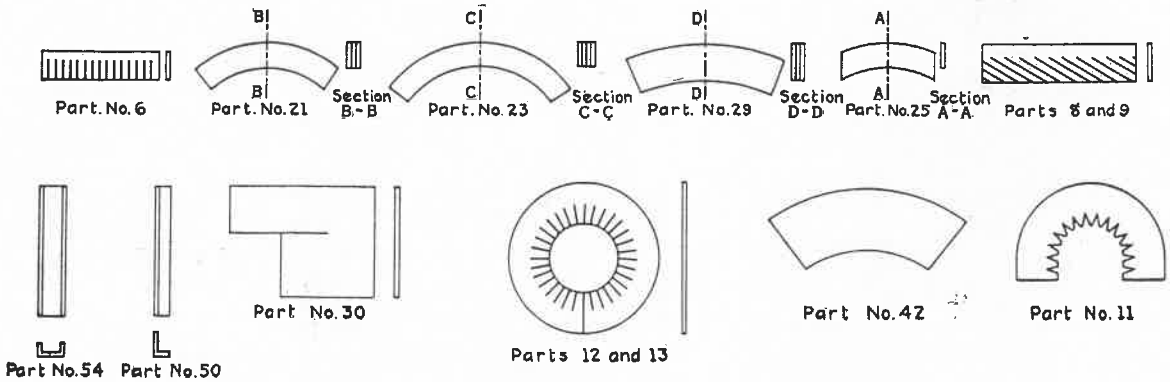
*Cat. No. 1639292G2 covers sufficient material to insulate one GE-265 core except tape and boot cord which are omitted because they are usually carried in bulk and cut to required length on the job.

Insulation Data for Typical Railway Motor—Type GE-265

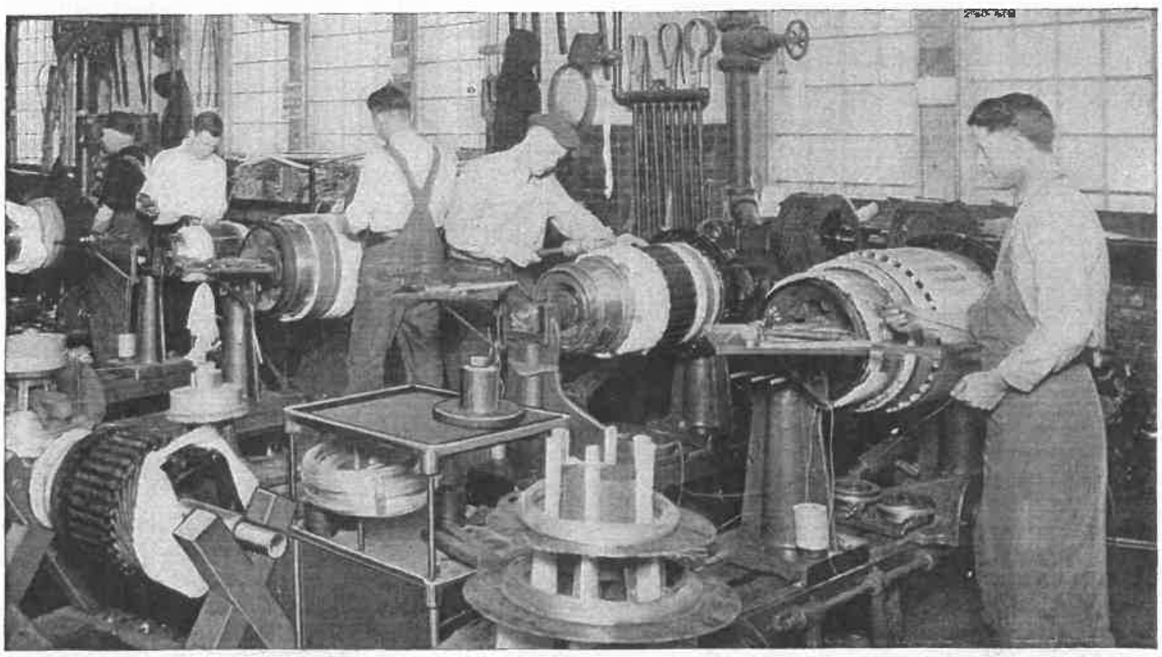
*WINDING AND CONNECTING INSULATION			
Part No.	Quant.	Material	Application
16	2	Acme Tape .012"X$\frac{3}{4}$"X15ft.0"	Cushion for Coils (Close to Punchings Both Ends)
17	25	Treated Press Board	Slot Strip, Bottom of Slot
18	50	Mica	Slot Armor (Both Ends)
19	25	Treated Press Board	Slot Strip (Between Upper and Lower Coils)
20	25	Treated Press Board	Slot Strip (Between Upper and Lower Coils)
21	2	Varnished Cloth and Treated Duck	Insulation (Between Bottom Leads and Coils)
22	1	Acme Tape .012"X$\frac{3}{4}$"X6ft.0"	Binding Over Part No. 21
23	4	Varnished Cloth, Treated Duck, Treated Muslin	Insulation (Between Upper and Lower Coils Both Ends)
24	6	Treated Press Board	Strip (To Stiffen End Loops Both Ends)
25	40	Treated Press Board	Spacer Bet. Adjacent Coils (Both Ends)
26	1	Non Elastic Webbing	Strip (Between Lower Leads Next to Commutator) Comm. End
27	1	Treated Rope	Filler (Between Leads at End of Coil)
28	2	Acme Tape .012"X$\frac{3}{4}$"X8ft.0."	Binder Over Parts Nos. 27 and 29
29	6	Varnished Cloth and Treated Duck	Insulation (Between Upper Leads and Coil)
30	25	Treated Drill	Patch (Between Adjacent Coils and Loops) Pinion End

*TOP DRESSING, BINDING AND CLIPS			
Part No.	Quant.	Material	Application
36	1	Treated Duck	Insulation Base (Comm. End)
37	1	Boot Cord No.7, .040"X68 ft. 0"	Filler Over Leads (Close to Comm. Ear)
38	2	Acme Tape .012"X$\frac{3}{4}$"X5ft.6"	Binder Over Parts Nos. 36 and 47
39	1	Acme Tape .012"X$\frac{3}{4}$"X5ft.0"	Insulation (Two Layers Over Comm. Ears)
40	1	Varnished Cloth	Insulation (Comm. End)
41	2	Acme Tape .012"X$\frac{3}{4}$"X16ft.0"	Binder Over Parts Nos. 40 and 48
42	1	Duck	Body Band (Comm. End)
43	2	Boot Cord No.7, .040"X32ft.0"	Binder Over Parts Nos. 11 and 42
44	1	Stay Binding	Binder for Part No. 42 (Cover Edge Comm. End)
45	2	Tinned Steel Wire .045"X102ft.0"	Binding Band (38 Turns) (Comm. and Pinion End Winding)
46	16	Tinned Steel	Clip for Part No. 45
47	1	Treated Duck	Insulation Base (Pinion End)
48	1	Varnished Cloth	Insulation (Pinion End)
49	1	Cotton Drill	Dummy Hood (Pinion End)
50	2	Treated Horn Fibre	Strip Under Part No. 53
51	6	Tinned Steel	Tie Clip (For Parts Nos. 53 and 55 Two Each)
52	18	Tinned Steel	Clip for Parts Nos. 53 and 55
53	2	Tinned Steel Wire .045"X34ft.0"	Binding Band (11 Turns) (Core Ends)
54	1	Treated Horn Fibre	Strip Under Part No. 55
55	1	Tinned Steel Wire .045"X34ft.0"	Binding Band (12 Turns) (Core)
56	1	Non Elastic, Webbing	Insulation (Over Bead of Comm. Cap)
57	1	Treated Cord	Binder Over Part No. 56

*Cat. No. 269656 covers sufficient material to rewind one GE-265 armature except tape, wire and boot cord which are omitted because they are usually carried in bulk and cut to required length on the job. Parts 56 and 57 are not needed in rewinding and are not included in this Cat. No.



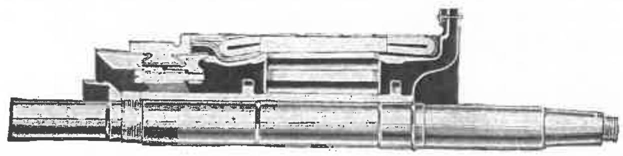
Insulation Details For GE-265 Armature



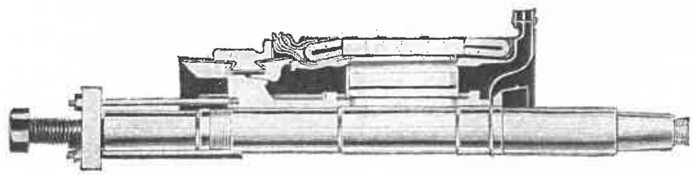
G-E Service Shop used exclusively for the repair of customers' apparatus

In making repairs to the commutator, especial care should be taken to keep all parts clean and free from dust and foreign material. Careful work is essential for the best results.

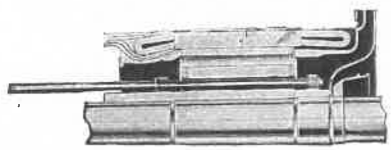
Views of Armature with Bolted Type Commutator



Normal Operating Condition

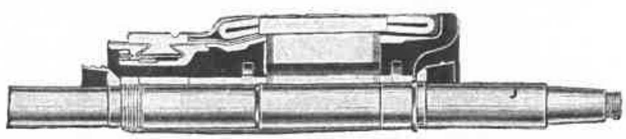


Showing Bolts for Removing Commutator

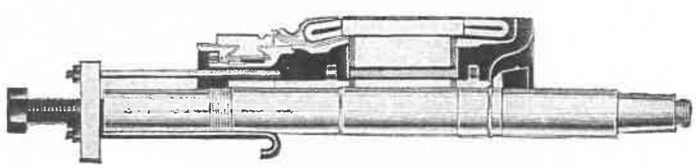


Shaft and Commutator Removed

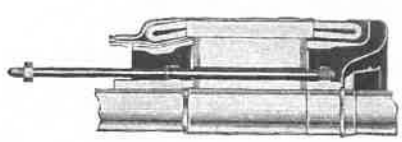
Views of Armature with Ring Nut Type Commutator



Normal Operating Condition



Showing Hook Bolts for Removing Commutator



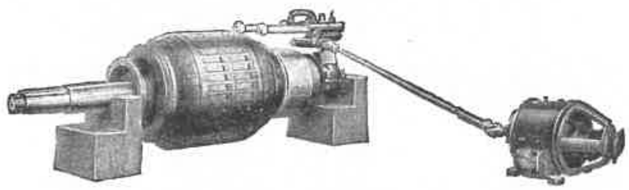
Shaft and Commutator Removed

Removal and Replacement of Complete Commutators

In case the commutator as a whole must be replaced, the above illustrations show methods of removing it from the shaft for both the bolted and the ring nut types of commutators. Note the bolts used for clamping the core laminations together while the armature nut is removed.

Commutator Grooving Machines

Portable and Stationary Types



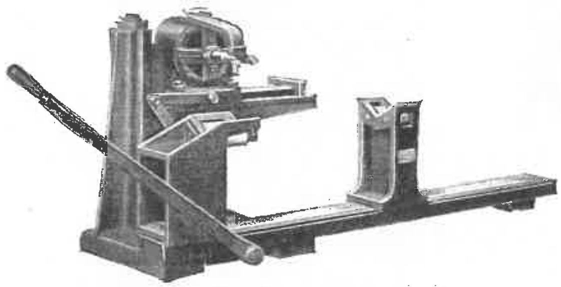
PORTABLE MACHINES—FORM 3

The Form 3 machine is a simple portable outfit which can readily be moved to any part of the shop clamped to the armature and thus completely groove the commutator in a few minutes.

This machine has adjustable stops, which direct the travel of the saw to the brush surface c the commutator. It is equipped with a floating driving shaft which permits the grooving of a numbe of slots at one setting of the armature and an angular adjustment which can be used when the com mutator bars are not exactly parallel to the shaft.

Loosening of the clamp bolts is unnecessary as a slight tap with the hand readily shifts the sa from slot to slot. The clamp is lined and will not mar the armature shaft.

The driving shaft is equipped with universal toggle joints and provision is made for either bel or motor drive.



STATIONARY MACHINES—FORM 2

The Form 2 machine meets the need of large railways for a stationary shop tool.

The base is provided with adjustable pillow blocks having "V" shaped bearing surfaces wit brass rollers.

The slide arm is designed for both vertical and angular adjustment, the latter adjustment to b used where the commutator bars are not exactly parallel to the shaft.

The rotating saw is mounted on the end of the motor shaft which is extended and supported b an offset bearing, which readily permits the grooving of commutators having ears. Owing to the sma size of the motors used with these machines, no starting resistance is necessary.

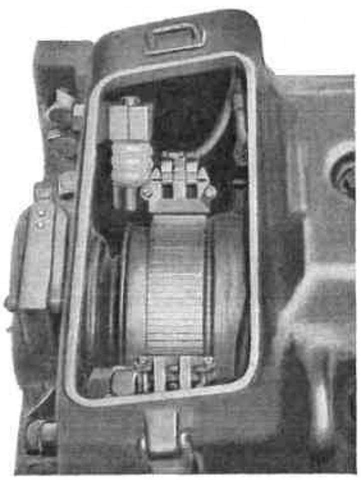
COMMUTATOR HAND SCRAPER

The hand scraper is for removing mica fins which are left in the slot by the grooving saw. triangular curved file is sometimes used for removing the copper projections, but the removal of very thin portion of the commutator surface by turning in a lathe using a special high-speed steel toc (trade name No. 3 Stellite), is recommended. The remaining copper burr left on the trailing edge c each commutator bar can be removed by the hand scraper above illustrated. A final polishing wit sandpaper will make a smooth surface which is necessary for good commutation and long life of brush.

Better Commutation

for

Railway Motors



The commutation of railway motors can be improved by carrying out the following recommendations:

1. Keep commutator mica segments undercut or grooved; cutting depth about $\frac{3}{64}$ inch.

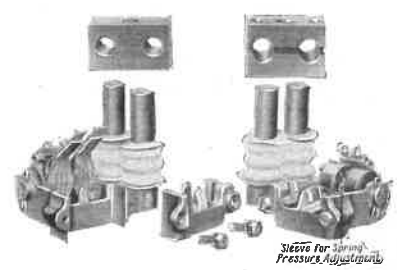
2. Keep commutator surface smooth.

3. Use best grade of brush made of highest quality materials. Selection of brush depends upon local conditions and design of motor involved. See descriptive sheet 64404.

4. Do not allow oil to come in contact with commutator mica or carbon brushes.

5. Keep bottom of carbon box between $\frac{1}{8}$ and $\frac{1}{4}$ inch away from commutator surface.

6. See that brush fits carbonway without excessive clearance, but is free to move in response to the brush pressure used. Maximum clearance between new brush and new carbonway is 0.008 inch. The clearance should not be allowed to exceed $\frac{1}{32}$ of an inch.



7. Replace worn carbonways promptly. Many motors are equipped with brush-holders having *renewable* carbonways.

8. Clean brush-holders and supports regularly. Moisture or dust on any part of brush-holder or support may cause failure.

9. Keep armature linings in good condition so that air gap will be maintained uniform. This will minimize the movement of the armature in going over rough track, which tends to cause flashover.

10. Maintain proper brush pressure. It is advisable to follow the brush manufacturer's recommendations on the pressure to use. The pressure depends on the type of brush as well as the local conditions of service. It is essential that the pressure be sufficient to keep the brush on the commutator at all times.

11. Keep track and road bed in good condition. Rough track is the cause of many commutation troubles.

Carbon Brushes for Railway Motors

Self-Lubricating, Low Resistance Brush

For use on grooved commutators

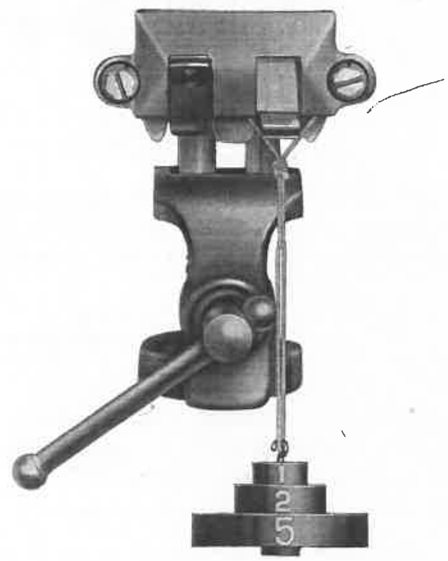
Under favorable conditions, such as absence of excess overloads, destructive vibration, an flashing, the use of a non-abrasive, low resistance brush is recommended for commutating po motors. A brush of this character causes minimum brush friction and minimum wear on th commutator.

The G-E Grade D brush meets these requirements.

Brush Pressure Adjustment

Brush troubles are frequently caused by using pressures entirely unsuited to the brush. Too litt pressure allows the brush to jump, often causing a flashover. It is necessary to use a high brus pressure on lines having rough tracks. The pressure should be sufficient to keep the brush on th commutator at all times.

Spring Balance Method



Weight Method

Methods of Measuring Brush Pressure

When measuring brush pressure by either of the methods illustrated above, it is recommende that a wooden block of the same size as the brush be used. This should be grooved lengthwise to hol the cord. If the wooden block is omitted, care must be taken to place the cord around the finger at th center of the carbonway, otherwise an incorrect reading will be taken.

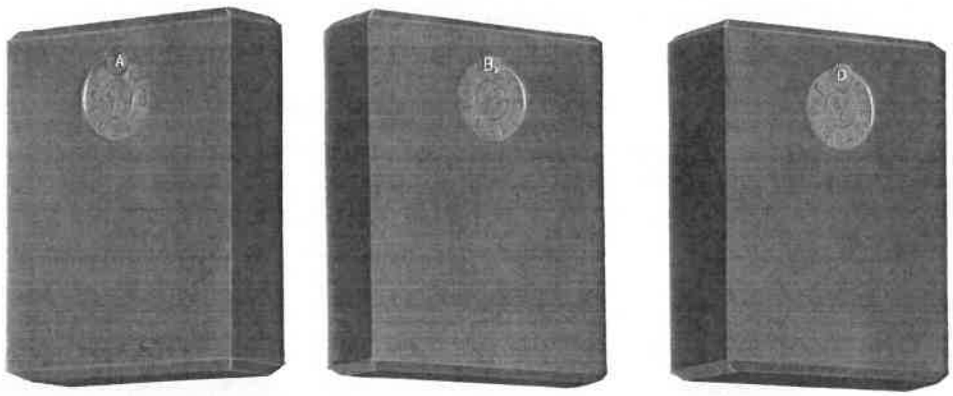
There are few motors which allow sufficient space within the motor to measure pressure on bot brush-holders with the spring balance. However, it is always desirable and generally necessary t remove the brush-holder from the motor in taking measurements of brush pressure.

In the weight method, a weight equal to the proper pressure is applied as shown in the abov illustration. If the weight does not just balance the pressure of the finger, the ratchet adjustmen on the brush-holder should be changed. This operation should be repeated until proper adjustmen is made.

CARBON BRUSHES

for

Railway Motors



Brush Selection

The selection of the brush to use is governed by the type of motor and local service conditions. It is impossible to make a specific recommendation which will apply to every operating condition, but the following suggestions will be helpful in the majority of cases.

Abrasive, High Resistance Brush

For use on commutators not grooved

Motors having commutator side mica flush with the commutator surface require a brush with an abrasive content sufficient to cut the mica. Non-commutating pole motors generally require a comparatively high resistance brush to reduce the current in the coil short circuited by the brush. The brush must also have ample current carrying capacity.

The G-E Grade A brush meets these requirements.

Semi Self-Lubricating, High Resistance Brush

For use on grooved commutators

Motors subject at times to heavy overloads, which may cause burning or pitting of the commutator, generally require a semi self-lubricating brush containing just enough abrasive to keep the commutator smooth. Where commutation is affected by excessive vibration and possible flashing, a medium abrasive brush is also required. Such a brush usually has sufficient resistance to properly commutate the current in non-commutating pole motors.

The G-E Grade B-2 brush meets these requirements.

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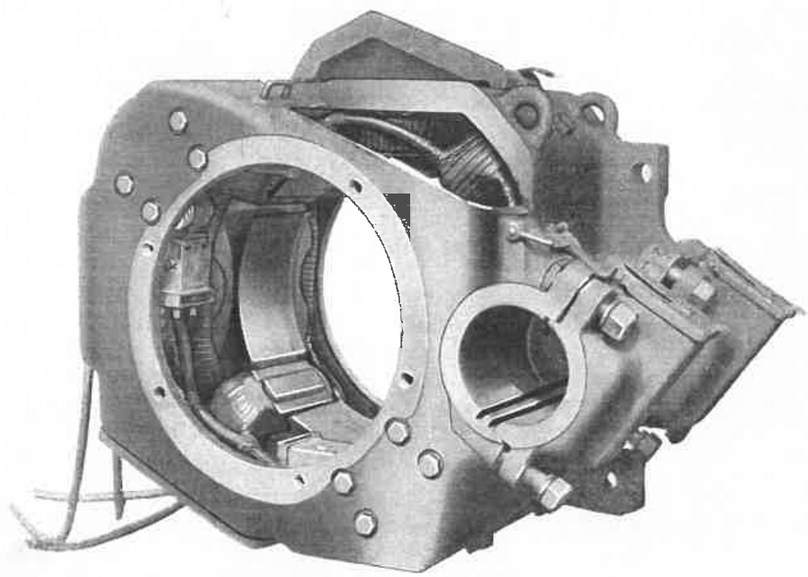
Railway Motor Field Coils

Round Conductor

Rectangular Conductor

The question of using aluminum field coils for replacements in existing motors is one which shoul be decided upon only with full knowledge of the motor design. In any case, the use of aluminum fiel coils does not obtain maximum capacity from the motor. It may be possible in an extremely sma number of cases to use rectangular conductor aluminum insulated between turns by an oxide fil instead of round conductor copper with thicker insulation and retain the same field strength and sam resistance. In such cases, the use of rectangular conductor copper coils would actually increas the capacity of the motor, while the use of aluminum coils may actually reduce the capacity.

Most modern railway motors are designed with rectangular copper conductor field coils. N space is available around the coils except that necessary for proper ventilation. Aluminum field coil substituted in these motors must be of higher resistance or have a smaller number of turns. If th number of turns is affected, the field strength and speed of the motor is changed and commutatio troubles may be expected. If the resistance is increased, the heat will increase, and the temperatu rise in the armature as well as in the field coils may be destructive. Even though aluminum oxide i sufficient insulation between turns, the insulation between conductor layers and on the outside of th coil must be of higher dielectric and mechanical strength. Materials of such insulation must be simila to those used on copper coils which are affected by high temperature.

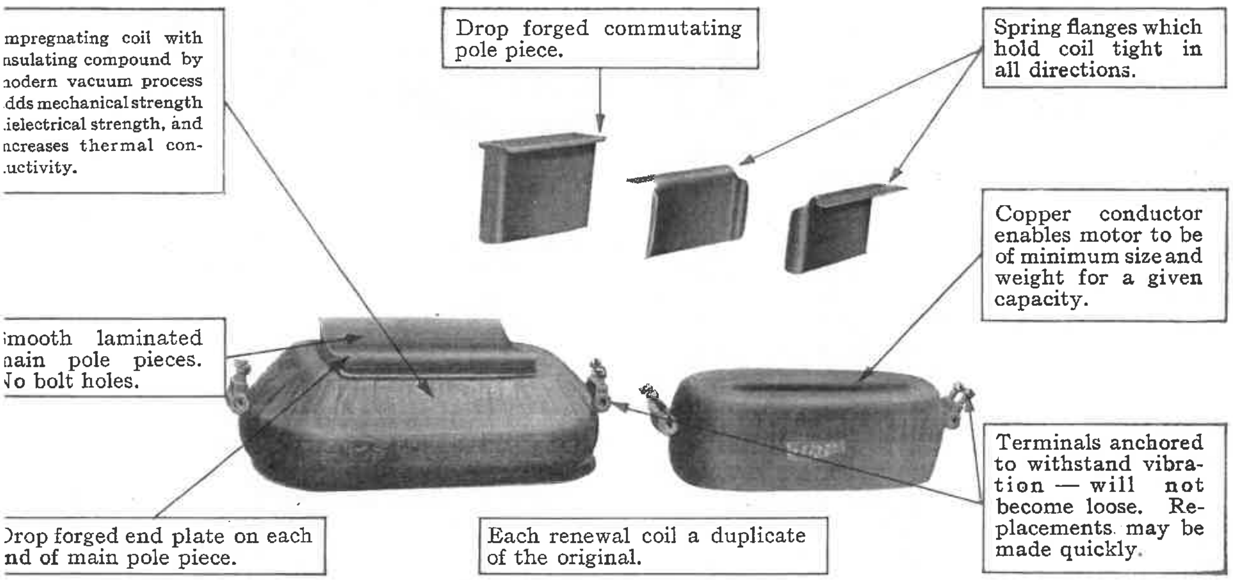


G-E Railway Motor Showing Field Coils in Place

Summarizing the above statements, the following features are embodied in or result from the use G-E copper field coils.

1. Minimum weight of motor
2. Minimum size of motor
3. Proper ventilation of motor
4. Proper commutation
5. Reliable insulation
6. Minimum heating
7. Long life
8. Few renewals
9. Low initial cost of motor
10. Minimum total cost

Railway Motor Field Coils



Field Coils, Pole Pieces and Spring Flanges

In general, G-E railway motors are equipped with the *mummy type* field coils but in some nstances among the older motors the *spool type* construction is utilized. This latter consists of a metal pool with strip or round conductor. The term "mummy" denotes a coil which is form wound and ompletely wrapped with insulating material.

NSULATION

After the coil (either mummy or spool type) has been wound, it is filled with an asphaltum compound by a vacuum pressure process. The compound penetrates all the interstices of the winding, ermetically sealing the coil against the entrance of moisture and so improving its thermal conductivity hat the heat generated is rapidly dissipated.

The mummy type of coil, after impregnation, is dipped in heavy insulating varnish and given a umber of wrappings, half lapped, of wet varnished cambric. The number of wrappings depends upon he voltage for which the coil is designed. The coils are then wrapped with heavy cotton webbing, alf-lapped, and given several dippings in black baking varnish, a baking period following each dipping —some of the smaller coils are wrapped with stay binding instead of cotton webbing—the coils thus roduced have very high insulation resistance and are impervious to moisture.

ONDUCTOR

Copper conductor is used in all G-E railway motor field coils. Its advantages over other conducors are that it allows the motor to be of minimum size and weight for a given capacity. Aluminum, or example, is lighter in weight but must be approximately 59 per cent larger in cross section for the ame conductivity. Such increase in size would necessitate the use of a larger magnet frame and arger pole pieces. The increased weight of these parts would more than offset the reduction in weight of the coils themselves.

Ask our nearest office for complete information

General Electric Company, Schenectady, N. Y.

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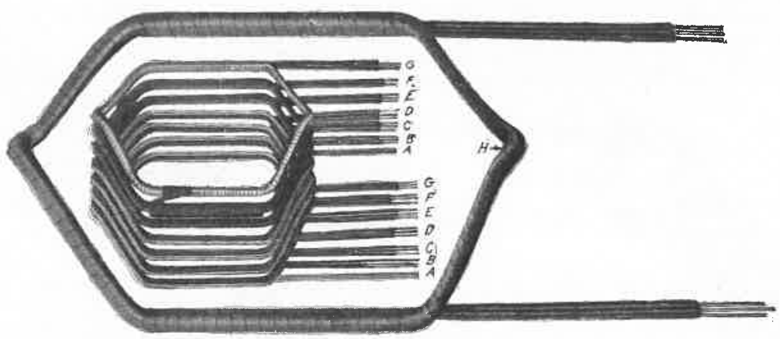
Railway Motor Armature Coils



The Evolution of an Armature Coil Showing Stages in Development

A—Armature Coil as wound on form.
B—Insulation coated with bonding material inserted.
C—Stocking slipped over leads.
D—Slot portion steam moulded.
E—Coil dipped in insulating compound.
F—Wrapping on slot insulation.
G—Taping, showing additional top spacer.
H—Completed coil.

Armature coils in original equipments are especially designed to meet the exacting servi required of a particular motor. The conductors are of ample size properly insulated for maximu life. The slot portion of the coil is bonded into a solid unit by the use of heated moulds makii assembly easier and greatly reducing liability of damage to the conductors. The leads are cleane tinned and carefully inspected to eliminate burrs. A stocking is slipped over each lead and secure fastened. This stocking is especially treated to prevent drying out and consequent stiffening and prevent unravelling of the insulation on the conductors. The completed coil is dipped several tim in varnish and thoroughly baked after each dipping.

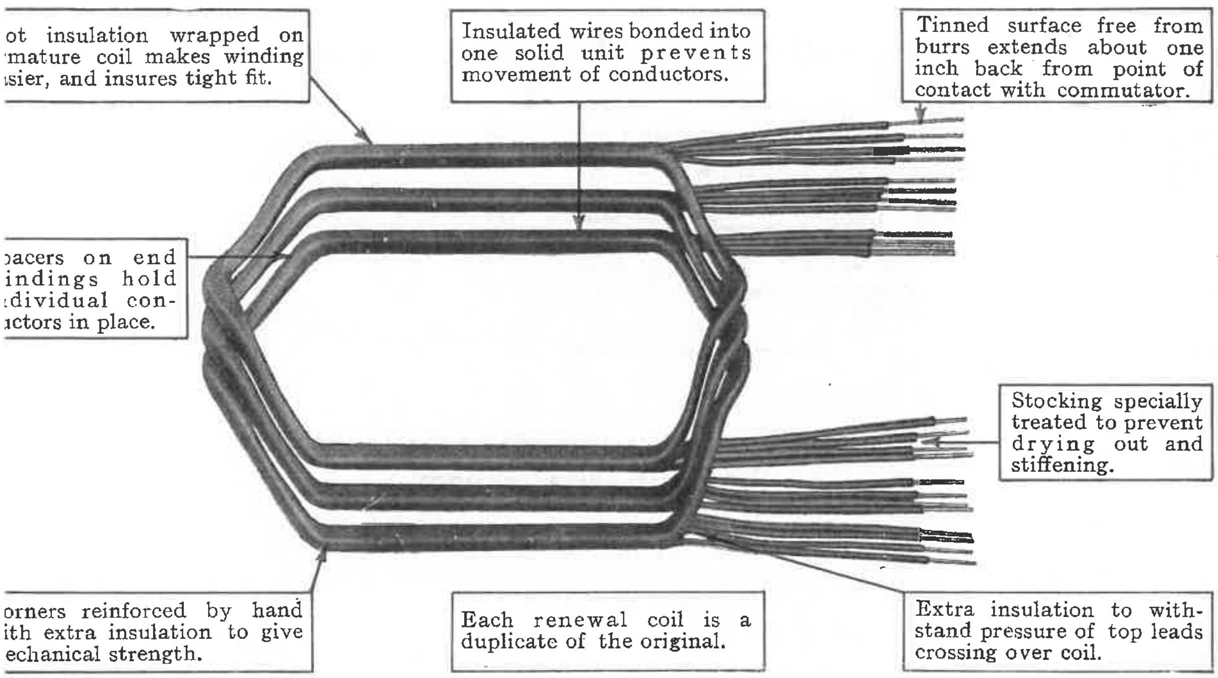
Only by the use of coils made of the same materials and in exactly the same manner can tl original quality of the equipment be maintained. Coils made in any other manner will not have tl exact fit necessary for easy winding on the one hand or the tightness in the slots to withstand vibr tion on the other. If inferior materials are used the coils will deteriorate rapidly under severe servi conditions. Coils designed simply to produce an interchangeable product at a lower price cannot the work as well as the equipment manufacturer's high standard product.

G-E coils are made for G-E motors to perform a particular service under carefully analyz conditions. The same care that is used in selecting original equipment should be exercised in tl selection of repair parts for it.

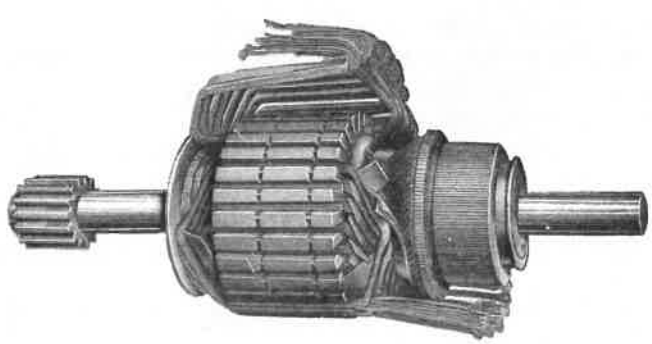
Each G-E coil is a duplicate of the original. The use of G-E replacement coils insures sati factory operation of G-E motors and minimum maintenance expense.

General Electric Company

Railway Motor Armature Coils



Coils for railway motors are subjected to the most difficult service of any electrical equipment. This is due largely to the vibration and unfavorable conditions, such as exposure to dirt and moisture, under which these motors operate. Particular care must therefore be taken to prevent any possible movement of the coil in the core slots as such motion or vibration is sure to result sooner or later in a grounded or short circuited armature. The importance of a properly fitting coil cannot be too strongly emphasized, as the life of the coil depends to a very great extent on the prevention of abrasion in the slot and between individual turns. The coil must have a good tight fit, taking up all the available space in the slot and, at the same time, not so tight as to be damaged in assembling the coils on the armature. While an armature may be wound much more quickly if the coils slip into the slots easily, the saving in labor and ease in winding is offset by the much shorter life of such loose fitting coils.



Railway Motor Armature, Partially Wound

General Electric Company, Schenectady, N. Y.

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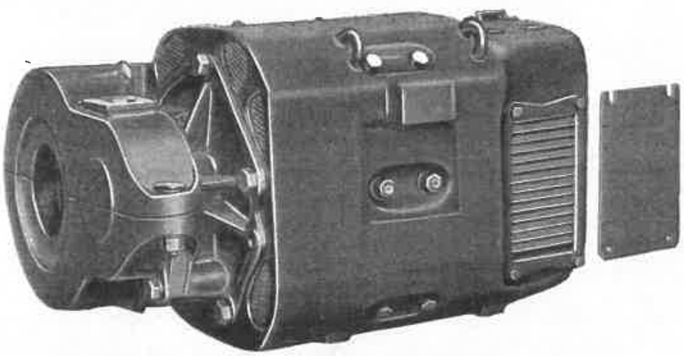
Winter Covers for Ventilated Railway Motors



TYPE GE-254 FORM A MOTOR SHOWING WINTER COVER

Water

During thaws, in cases where tracks are not well drained, some trouble has been experienced fro water getting into the motors in sufficient quantities to cause burnouts, especially of the armatur or grounding of the brush-holders. This trouble is aggravated by salt which is often used by railro companies to prevent switches from freezing.

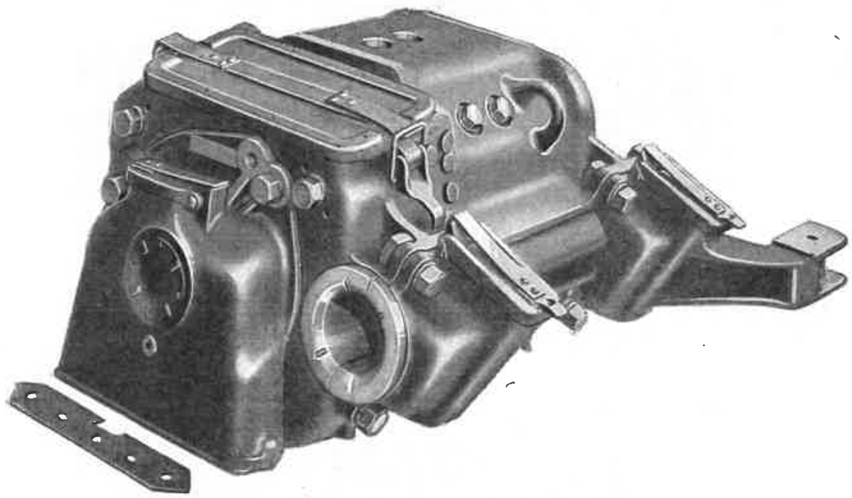
Cold Motors

In cold weather, cars may be run into the barn with the interior of the motors at a temperatu considerably below that of the barn, causing moisture to be deposited on the commutator and windin in an excessive amount. The service may be such that the motor is never heated sufficiently to dry o and a continued condensation of moisture eventually breaks down the insulation. Even witho extreme cold, atmospheric conditions may be such that moisture may form in the motors and it probable that the penetrating quality of moisture-laden air is more injurious to insulation than t occasional entrance of water from wheelwash.

These conditions may be improved by closing the intakes, causing the motors to operate at high temperature. Care must be taken, however, that this is not done when the service is such that the u of covers would cause overheating, although generally when motors come out of service with a ter perature rise not sufficient to prevent condensation in the car barn, they will operate at a safe ter perature with the covers on.

When covers are used, great care must be taken against overheating the motors by bucking snc drifts, also to remove the covers before the arrival of warm weather.

Winter Covers for Ventilated Railway Motors



TYPE GE-265 FORM A MOTOR SHOWING WINTER COVER

It has been found advisable in some instances to use covers over the intake openings of ventilated motors during severe winter weather to prevent the entrance of snow and water. The need of covers applies more to multiple ventilated motors although in a few cases it has been found desirable to use them with motors having series ventilation. When ordering covers for winter use, the serial numbers of the motors for which these covers are intended should always be specified.

Snow

Where trouble has been caused by the entrance of snow, it has usually been where severe storms of fine light drifting snow have been encountered. This kind of snow may be blown into the motors in sufficient quantities to cause damage. It is more liable to occur in interurban service and in open country than in the city service where snow is generally more tightly packed down. At higher speeds there is frequently a cloud of fine snow swept up and carried along by the car, which may be drawn into the motor. Under such conditions the use of winter covers may be found advisable.

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METHODS OF REMOVING THE ARMATURE FROM BOX FRAME RAILWAY MOTORS

By J. L. BOOTH

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METHODS OF REMOVING THE ARMATURE FROM BOX FRAME RAILWAY MOTORS

By J. L. Booth

Railway Motor Engineering Department, General Electric Company

The box type of frame for railway motors was originally developed in order to meet the demand for motors capable of giving the large outputs required for heavy service on interurban, elevated and subway lines. In addition to possessing many advantages from a mechanical point of view, it enables the designer to obtain a considerable increase in capacity for a given weight and space, when compared with the split frame. As the advantages of this type of frame became more widely known and recognized among operating engineers, the demand for box frames increased until at the present time they are being used for motors of all sizes from the largest to the smallest, and have almost entirely superseded the split frame. From 80 to 90 per cent of the railway motors now being made are of the box frame type, and many of the most recent designs of motors are being built with this type of frame only.

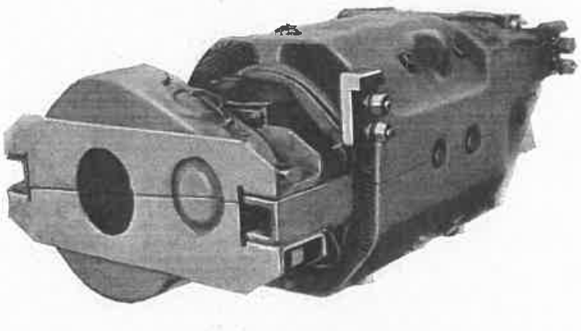


Fig. 1. Small Light-Weight Motor with box frame for small wheel cars

Advantages of the Box Frame

For a given space and weight, a larger output can be obtained than with a split frame, or for a given output the motor can be made both smaller and lighter. It also possesses greater structural strength and durability, and there is less chance of breakdowns due to the mechanical failure of parts of the machine, or the breakage of bolts. The lower half of malleable iron gear cases may be supported in a more substantial manner rendering them better able to withstand the severe stresses to which they are frequently subjected. The elimination of the joint in the frame, in addition to giving an unbroken magnetic circuit, prevents oil from working into the interior of the motor from the axle bearings, which is always liable to occur through the joint in a split frame.

From the absence of this joint, which is usually horizontal, a greater freedom of design is generally obtained for the armature, pole pieces, and coils, and for the same reason a better axle preparation and design of axle bearing housings is made possible.

With a ventilated motor, in which air is drawn through the frame and armature core, a greater space is available in the frame for the passage of the cooling air around the field coils. This allows unrestricted ventilation with a corresponding increase in the service capacity of the motor. Better protection is afforded to the field coil connections which, in the box frame motor, are all inside the frame. By removing the motor from the truck repairs are effected, bearings seated and connections made under favorable conditions to insure good workmanship, while with the split frame the work is often done from the pit in a cramped position and under poor lighting and working conditions.

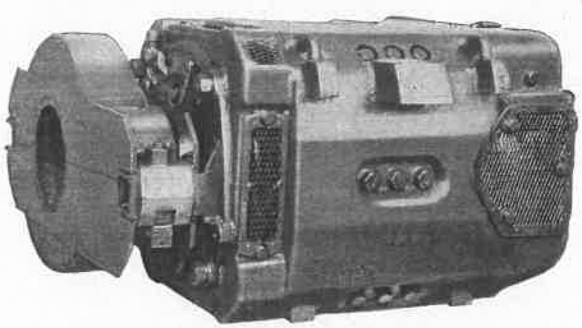


Fig. 2. 160-H.P. Motor with box type of frame

There are also a fewer number of parts which are liable to work on each other and which ultimately require liners to take up wear. This together with the increased reliability of the box frame motor gives a low maintenance cost.

A typical example of a small box frame motor is shown in Fig. 1. This motor has been especially developed for use with light cars having small wheel trucks. It is built in the box frame type only and although of 35 h.p. rating weighs only about 1500 lb. Even in this size of motor it is possible to provide openings, both on the top and suspension side of the motor, of sufficient size to permit the thorough inspection of the commutator and brush-holders.

A large motor is shown in Fig. 2. This motor which rates at 160 h.p. weighs, complete with all parts, approximately 5720 lb.

Methods of Removing Armatures

When the box frame was first advocated it was felt by some operating engineers that the necessity of dismounting the motor from the truck in order to remove the armature, for repairs, would take so much time and keep a car out of service so long that the cost of repairs would largely offset the advantages of the box frame. Experience, however, has shown this not to be so, and by the provision of various simple appliances to facilitate the removal of armatures, repairs to box frame motors are today being executed just as rapidly as with split frames. Indeed, in the opinion of some operating engineers of roads where both types are in operation, inspection and repairs can be effected in less time with the box frame, due to the superior working conditions which exist when the motor is off the truck. In many cases the time necessary to have an armature "on the floor" after the car has been run in has been cut down to something very small, and the systematic inspection of motors at regular intervals of time or of distance run is materially reducing the cost of maintenance and repairs. It has been urged that for small roads operating single-truck cars, and not provided with the equipment for easily lifting the car body from the truck, the split frame can be more easily handled and should be used. The removal of the box frame motor, however, without taking out the truck from under the car, presents no great difficulty and is recommended for this type of car. The axle caps and bolts are first removed and the gear case taken down. The motor is then supported from the pit by a jack bearing against the center of the motor frame. The suspension bolts are next taken out (if of the bolted bar type) and the suspension bar unbolted from the truck. The motor may then be raised by the jack and moved away from the axle sufficiently far to allow the portion of the axle bearing housing that projects over the axle to clear it. The motor may then be

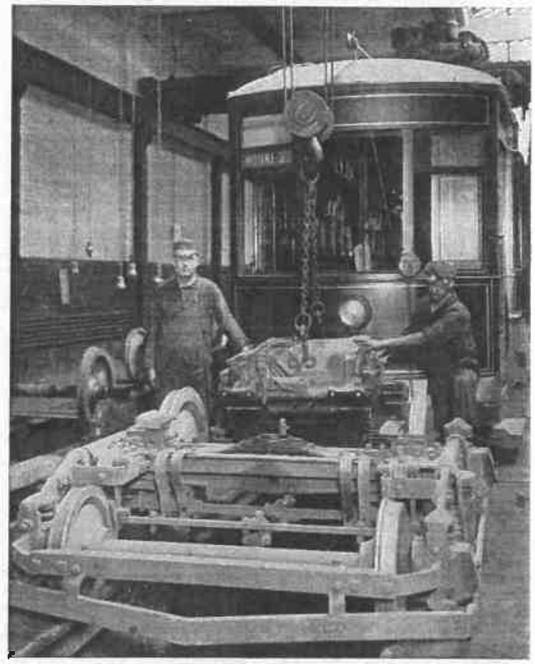


Fig. 3. Removing a 65-H.P. Box Frame Motor from the Truck. This operation takes fifteen minutes to perform

lowered into the pit. If preferred, the axle may be used as a fulcrum and the motor swung down around the axle until the bearing housings are clear. In any case, the motors generally used on single-truck cars are small, and the weight to be handled is not great. No elaborate equipment is required for removing a truck from a double-truck car. In most car barns, two pairs of chain blocks can be arranged to lift one end of the car while the truck is being removed, and it is not necessary to send the car to the main shops for the removal of an armature. Some examples are given here of the methods employed on various roads. Figs. 3, 4 and 5 show how GE-242 motors are being handled on a large system in the middle west. This motor is rated at 65 h.p. on 600 volts, and weighs with gear, gear case, pinion and axle linings approximately 3045 lb. The truck is run out from under the car, and the suspension bolts, gear case, axle caps and linings removed, the dust guard coming away with the axle caps.

The motor is then lifted out by means of the bails and an ordinary pair of chain slings (see Fig. 3). The four bolts securing the pinion end frame head are next removed and the head started by jack screws.

A lever, having a collar at one end which fits over and is clamped to the pinion, is used to support one end of the armature which is then pulled out sufficiently far to enable a wide lifting strap to be placed in position as shown in Fig. 4. The length of the bearing at the commutator end is sufficient to support that end of the armature until the lifting strap is in place.

By bearing down on the end of the lever, the weight of the armature can be balanced while being removed from the frame. Fig. 5 shows the armature clear of the frame, with the man's weight still on the lever, balancing the armature in the sling.

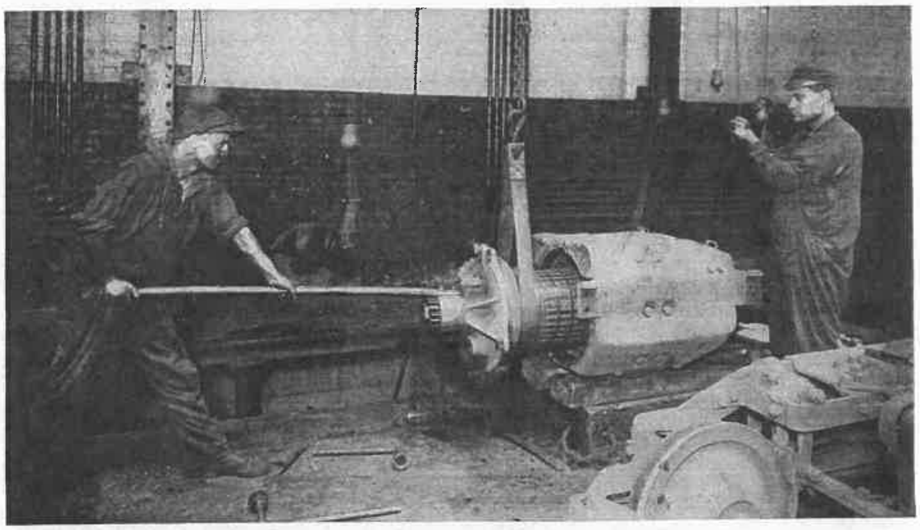


Fig. 4. Removing Armature from a 65-H.P. Box Frame Motor. Lifting strap in position. From the time the motor is off the truck until the armature is on the floor is twenty minutes

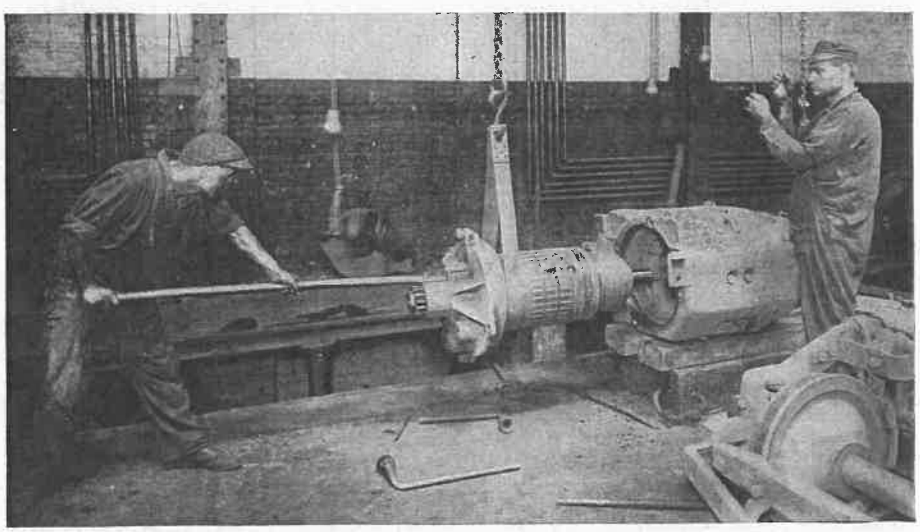


Fig. 5. Armature of a 65-H.P. Motor Removed. Man's weight on lever balances weight of armature. To replace armature and remount motor on truck takes twenty-five minutes

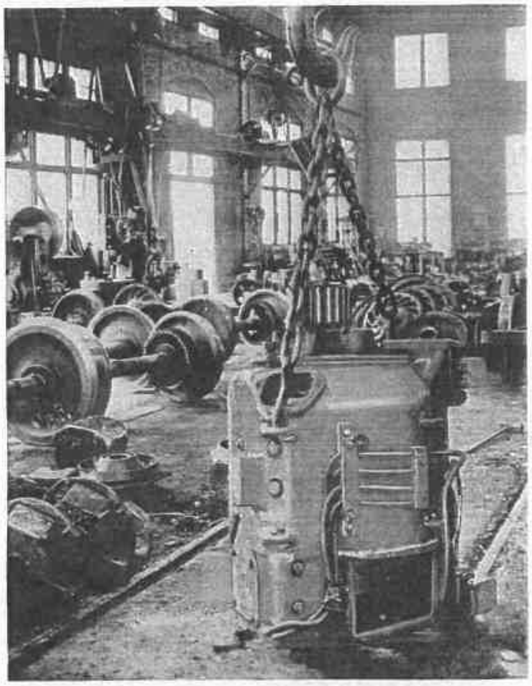


Fig. 6. A 140-H.P. Box Frame Motor removed from truck and turned on end preparatory to lifting out armature

It will be noticed that the pinion has not been removed, and that it is only necessary to remove the four bolts in the pinion end armature head, also that in this method, which avoids turning the motor on end, it is not necessary to remove the oil from the oil boxes.

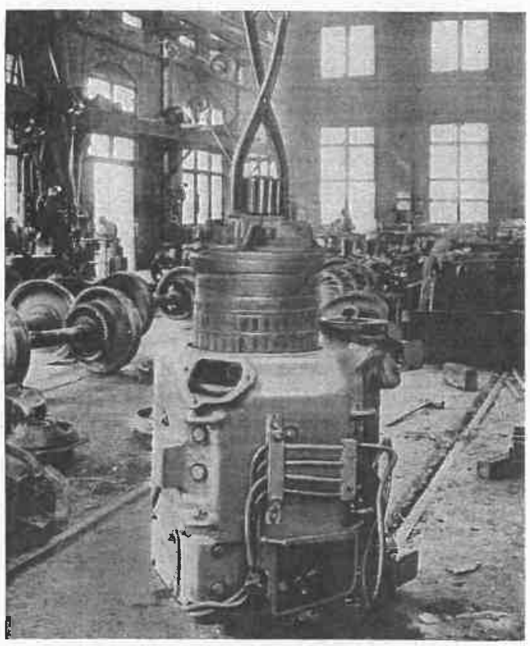


Fig. 7. Lifting out Armature of a 140-H.P. Box Frame Motor with scissors-like clamps which fit under pinion

The time necessary to remove and replace an armature after the truck has been taken out from under the car body is as follows:

To perform the first operation, that is, the removal of the axle caps and suspension bolts and raising the motor frame from the truck, takes 15 minutes.

The second operation, covering the removal of frame head bolts, forcing off frame head, clamping lever to pinion, placing lifting strap in position, removing armature and laying it on floor, requires 20 minutes.

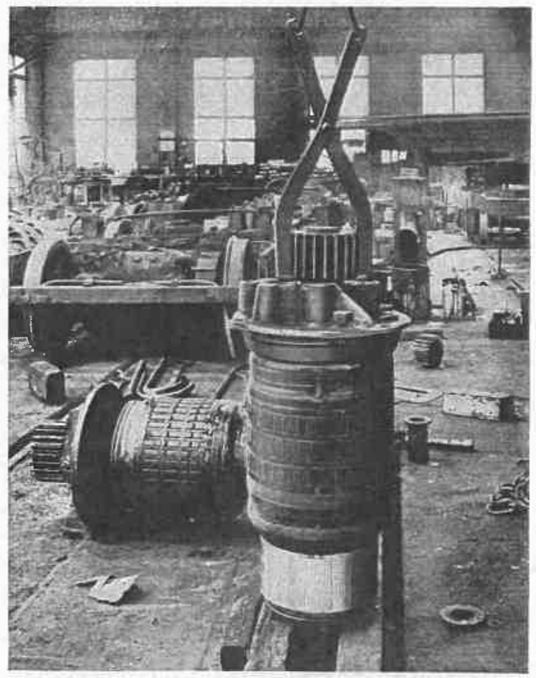


Fig. 8. The clamps are replaced by a light chain before laying the armature flat on the ground

The third operation, picking up armature, replacing it in shell, bolting up frame head, lifting motor and placing it on truck ready for service, takes 25 minutes.

This makes a total time of one hour from the time the truck is taken from under the car, until the motor is remounted and the truck ready to be replaced under the car body. This is, however, an average time and, under extraordinary circumstances, the work could and has been done in 45 minutes.

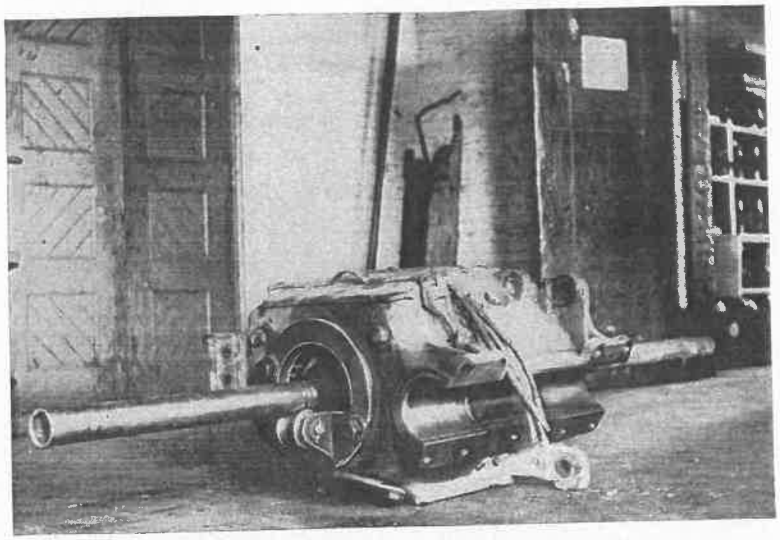


Fig. 9. Removing an armature by means of an extension of the armature shaft supported by a roller in a bracket bolted to the frame

Handling a Large Motor

Photographs are reproduced in Figs. 6, 7 and 8 showing the method adopted by another road for removing the armature from GE-222 motors. This is a 140-h.p. motor weighing complete with all parts 4260 lb. In this case, the motor is turned on end, after having been removed from the truck by slings in the usual manner. To turn the motor on end, the air intake pipe is removed, and a sling with hooks is attached to one of the bails on the motor frame, and to an eye bolt screwed into one of the axle cap bolt holes. For removing the armature the chain slings for taking the motor out of the truck, and for turning it on end, are replaced by scissors-like clamps which fit under the pinion teeth, The armature is then withdrawn, and stood vertically on blocks, while the clamps are replaced by a light chain before laying the armature flat on the ground.

A road operating a large number of GE-200 box frame motors is using an extension of the armature shaft to support one end while the latter is being dismounted. The pinion end frame head is removed, and the head at the commutator end replaced by a malleable iron bracket which fits the bore of the frame and is held in place by two tap bolts. This bracket carries a machined roller of such a diameter that the extension of the armature shaft, see Fig. 9, is kept in the center of the frame. This extension is a steel tube machined on the inside to just slip over the armature shaft. The shaft at the other end is supported by an oak pole 3 inches in diameter having a steel tube at one end of it that fits over the armature shaft. The armature is moved out

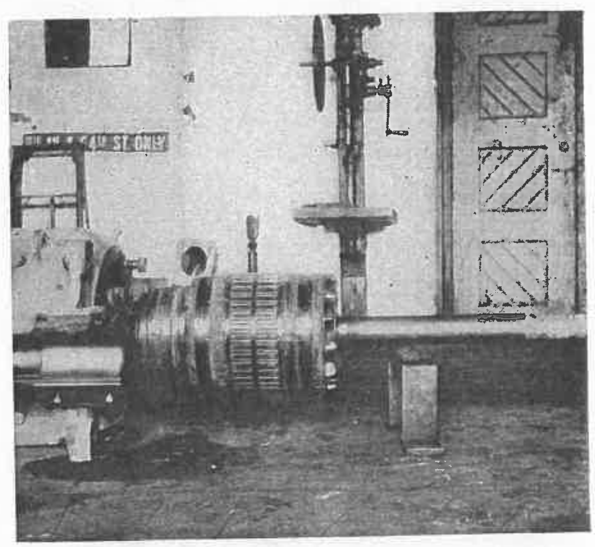


Fig. 10. The other end of shaft than that shown in Fig. 9 supported by an oak pole with a steel tube fitting over the shaft

horizontally and is supported at one end by the roller until it is clear of the frame.

Two somewhat similar methods are in use on another road for handling GE-210 motors. In one case the frame is stationary and the armature moved. An iron pipe having one

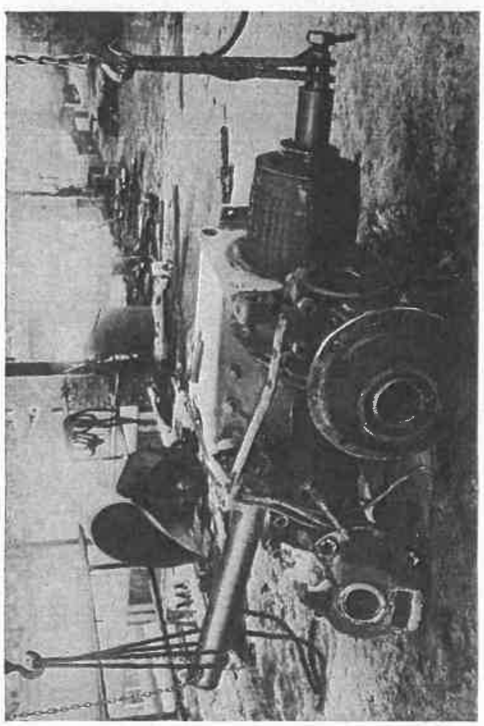


Fig. 11. An armature removed by overhead crane. Frame is stationary and armature is moved out horizontally

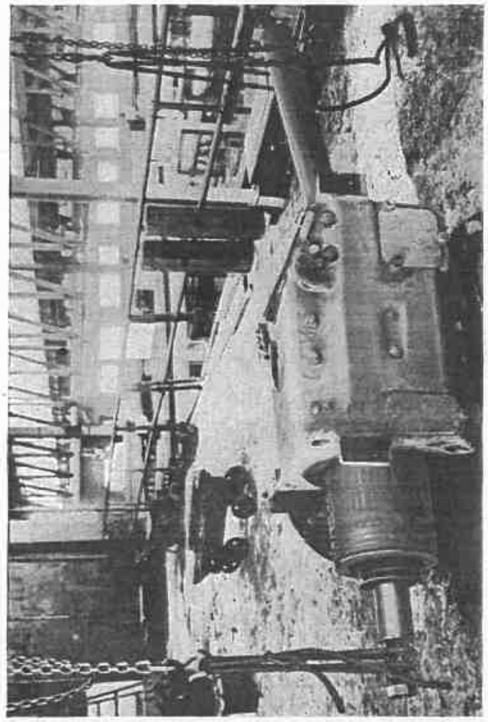


Fig. 12. One end of armature supported by a tube fitting over the armature shaft

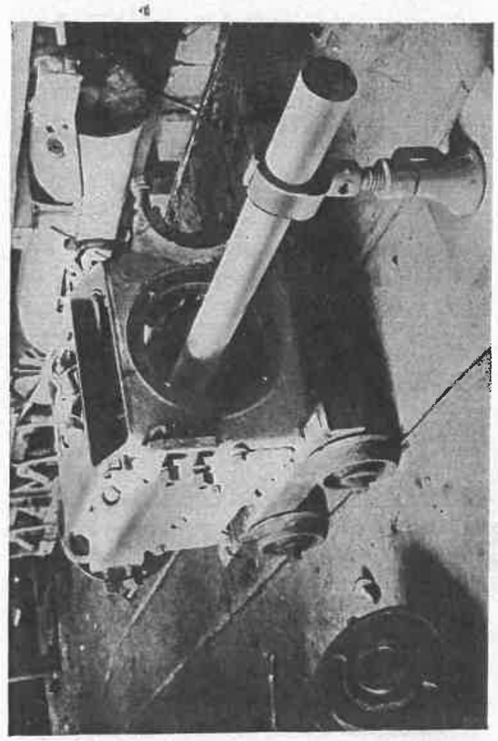


Fig. 13. The armature is held stationary and frame is moved horizontally on a truck

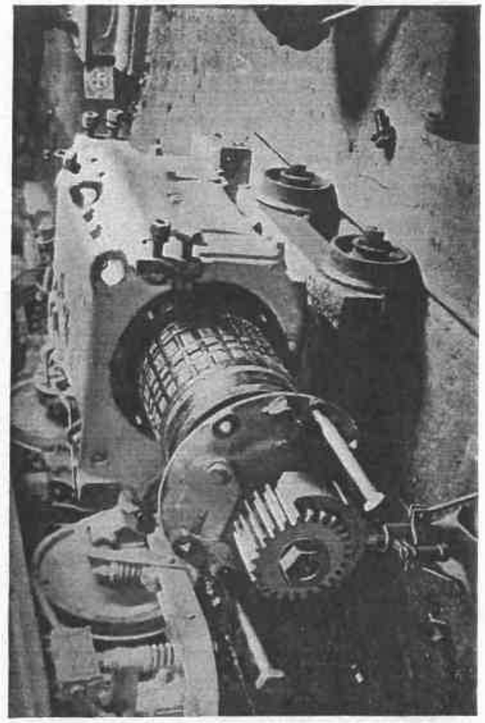


Fig. 14. The armature is supported by jacks which can be readily adjusted to take the weight of the armature off the pole pieces

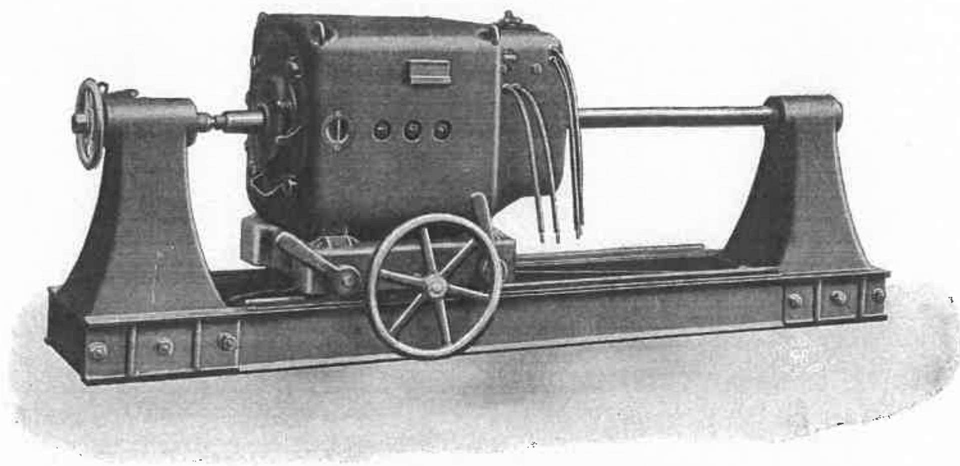
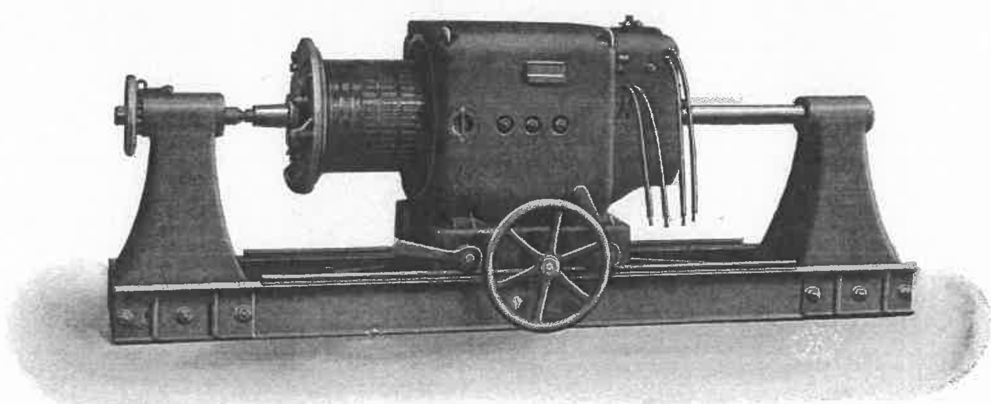


Fig. 15. A special machine for removing armatures from Box Frame Motors. Motor in place



Fip. 16. Frame-head bolts withdrawn and frame moved partially along the bed of the machine by means of the handwheel

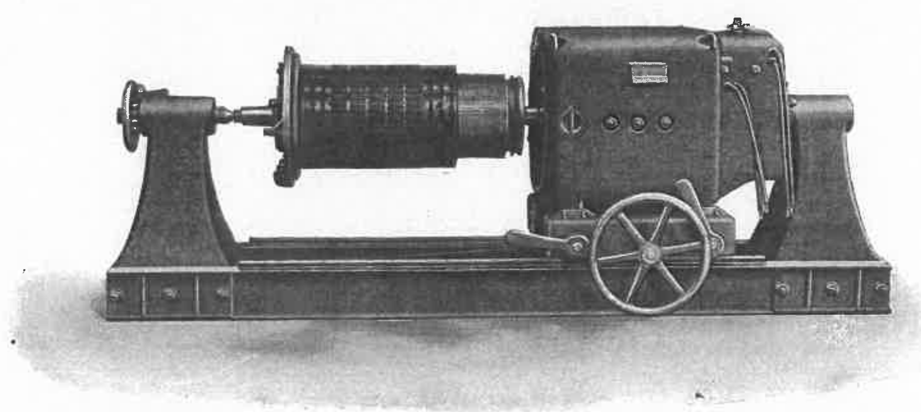


Fig. 17. Armature clear of frame and in a convenient position for examination and for effecting minor repairs

end bushed with brass, to avoid injury to the armature shaft, is used to support one end of the shaft. The armature is lifted by slings and moved out of the frame horizontally by an overhead traveller, see Figs. 11 and 12. The illustrations show the pinion and pinion end frame head removed from the shaft, though this is not actually necessary for the removal of the armature.

With the second method in use on this road, the armature is held stationary and the frame moved. Figs. 13 and 14 show this. The armature is supported by jacks, a bushed pipe being used at one end as before. The jacks can be readily adjusted to take the weight of the armature off the pole pieces, and the truck with the frame is moved along until the armature is clear.

This method is similar to that employed with the special machine shown in Figs. 15, 16 and 17. Although this involves the use of a special tool, it is simple and inexpensive to make and has many advantages.

The machine consists of a pair of centers, one of which is adjustable, mounted on a base which may be either a casting or built of channel bars. By using a long center instead of the pipe fitting over the armature shaft, the removal of the commutator frame head is avoided.

The table may be moved along the base by means of a hand wheel, and each of the supports on which the motor rests can be adjusted vertically by a lever.

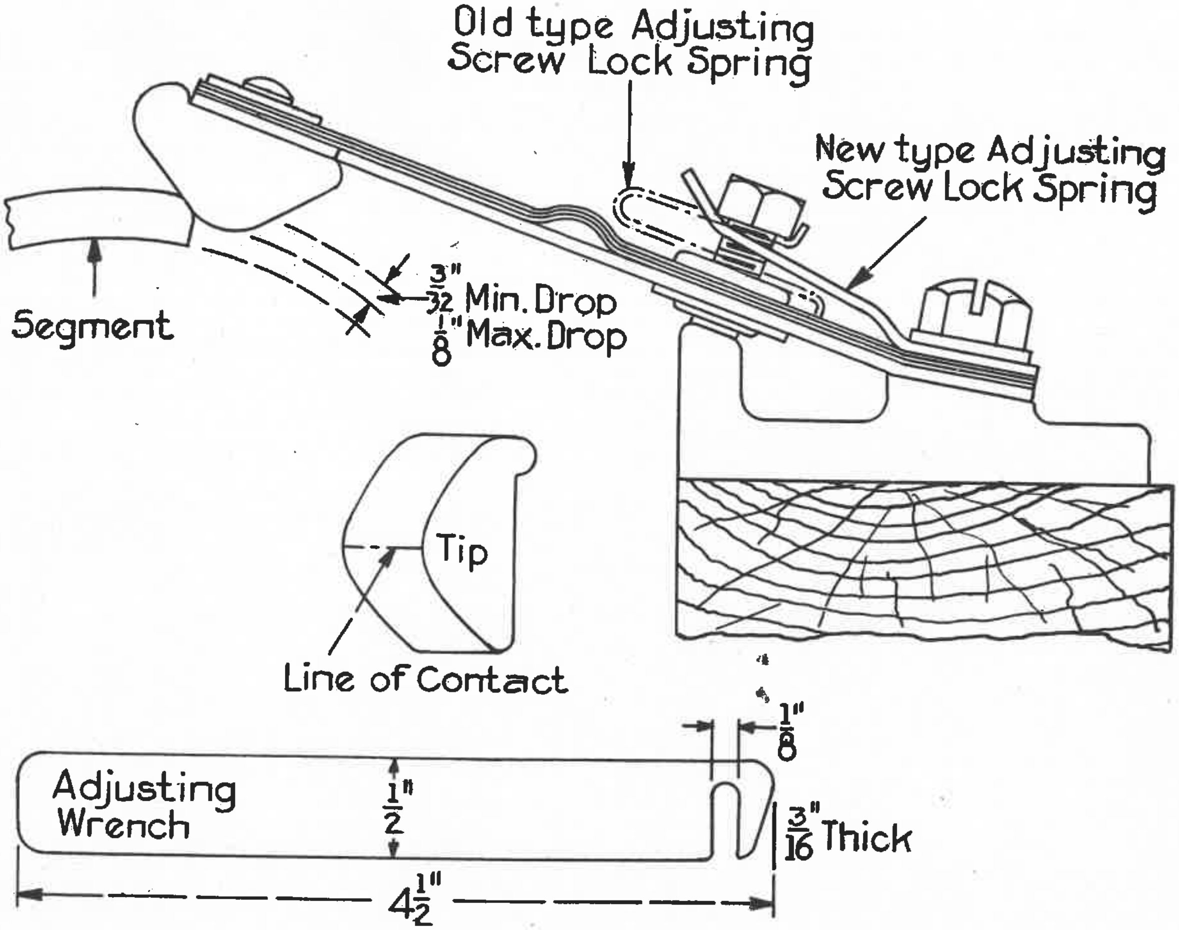
The motor is supported by the machined bosses on the bottom of the frame. The method of removing the armature is made evident by the photographs. It is unnecessary to remove the oil from the armature bearing oil boxes, and the armature and frame are in a very convenient position for inspection and making minor repairs.

These examples illustrate some of the means employed for the removal of armatures from box frame motors. Other appliances may be used where better suited to individual shops.

Adjustment

of

Drum Controller Fingers



Each finger of a drum controller is provided with an adjusting screw for limiting the movement of the finger as the tip breaks contact with the segment. This movement should not exceed ⅛ in. at the tip for easy operation of the controller and reasonable wear of fingers and segments, but must be at least $\frac{3}{32}$ in. for proper contact. The $\frac{3}{32}$-in. movement should be carefully checked in adjusting new fingers to operate on worn segments. If proper adjustments cannot be made, the segments are probably worn out and should be replaced.

The contact line of the finger tip should touch the segment at all points. If contact is not made all along this line, the finger should be twisted until such contact is made. If this is not done, both the finger and segment will overheat, causing the finger spring to soften and lose its tension. An adjusting wrench similar to the one illustrated above is useful in twisting the finger, so that the tip will make proper contact with the segment. This wrench will fit over the finger spring and shunt just back of the finger tip.

The tip should bear on the segment with a 6-pound pressure, measured at the line of contact.

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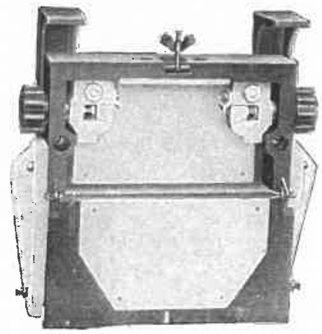
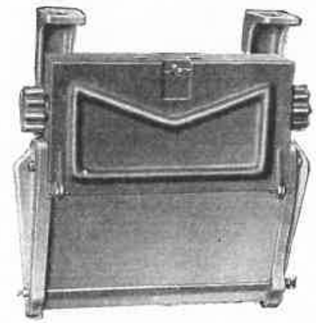
1-29-24

64600A
Supersedes 64600

MA-13-F FUSE BOX





The Type MA-13, Form F fuse box is rated 500 amperes at 600 volts and is suitable for use with motors of total capacity of 200 h.p. or less. The interior of the box is lined with sheet insulating material adapted to withstand the arc occasioned by the blowing of the fuse. The sides, top and back are moulded in one piece of a durable insulating material which will not soften and lose its shape under the influence of heat. The cover is held closed by means of a thumbscrew.

Method of Securing Fuse

The copper ribbon fuse is clamped at the ends by wedge-shaped blocks, drawn into place with hand screws, which exert high pressure on the surface of the fuse, insuring good contact. Access to the fuse is obtained by dropping the hinged cover of the box.

Magnetic Blowout

A valuable feature of this fuse box is the peculiar form of magnetic blowout employed. Unlike the ordinary method of obtaining a magnetic field, no coil is used, the flux set up about the fuse as a conductor alone producing it. The blowout effect is obtained by the special arrangement of soft iron plates or poles which, being brought together at the hinges, distribute the magnetic lines to the best advantage.

Pole Piece Construction

The pole pieces are punched from soft steel and embedded in the compound forming the sides and cover. They are brought out at either side near the bottom of the box, being curled up to act as hinges for the cover. The punchings on each side are made in two sections spaced approximately ¾ of an inch to prevent any possibility of the iron acting as a fuse in case the arc strikes the hinges when the fuse blows.

Arc Chute

The arc chute is completely enclosed, except for a small opening at the bottom. This renders the most severe arc practically invisible.

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MA-13-F FUSE BOX

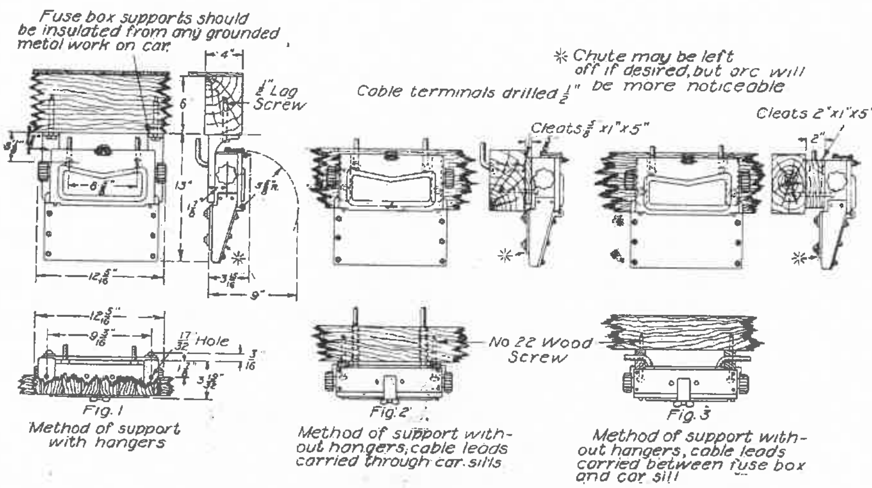
Connecting Fuse Box in Circuit

The terminal blocks are provided with tapered holes for receiving the tapered sleeves, into which the entering cables are to be soldered. The sleeves are drawn tightly into place by means of nuts secured by lock washers.

Method of Attaching Fuse Box to Car

For attaching the fuse box to the car, two malleable iron feet, one at each end, are fixed to the box, and holes for ½-in. bolts or lag screws are provided for its support to the bar beams or sills. These feet can be readily removed if desired, and the holes used for holding them to the box can be utilized for attaching the box to the car.

The relative advantages of the two methods of support depend largely upon the space available for the installation of the fuse box. The feet permit it to be placed in a hanging position, while without them, it can be clamped against a support at its back, as indicated in the diagram below.



Dimensions and Methods of Supporting MA-13 Fuse Box

Copper Ribbon Fuses

Ampere Rating	Cat. No. of Fuse	Copper Ribbon Data: Dimensions in Inches	Size of Hole in Inches	No. of Laminations
75	42504	0.005 by ¾ by 6⅝	9/16	1
100	38663	0.005 by ¾ by 6⅝	½	1
125	29428	0.005 by 1 by 6⅝	⅝	1
150	29429	0.005 by 1 by 6⅝	½	1
175	38664	0.007 by 1 by 6⅝	9/16	1
200	29430	0.005 by 1 by 6⅝	⅝	2
250	41248	0.007 by 1 by 6⅝	⅝	2
300	44306	0.005 by 1 by 6⅝	9/16	3
350	58225	0.005 by 1 by 6⅝	½	4
400	64858	0.007 by 1 by 6⅝	½	4
500	157027	0.007 by 1 by 6⅝	½	6

US-13-E TROLLEY BASE

For Railway Service

Cat. No. 601489

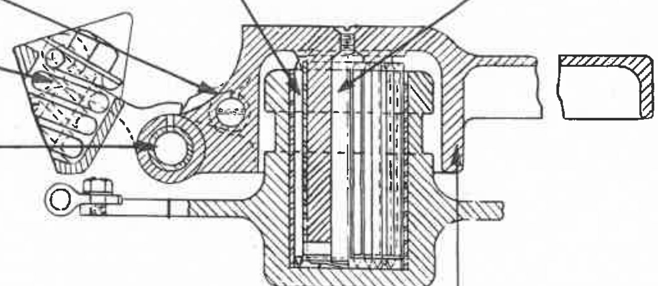
Buffer Spring cushions the pole socket in case the wheel leaves the wire.

Pole Changes made easy in the barn by aid of new locking device.

Rollers, Cage and Races are accurately machined and properly hardened.

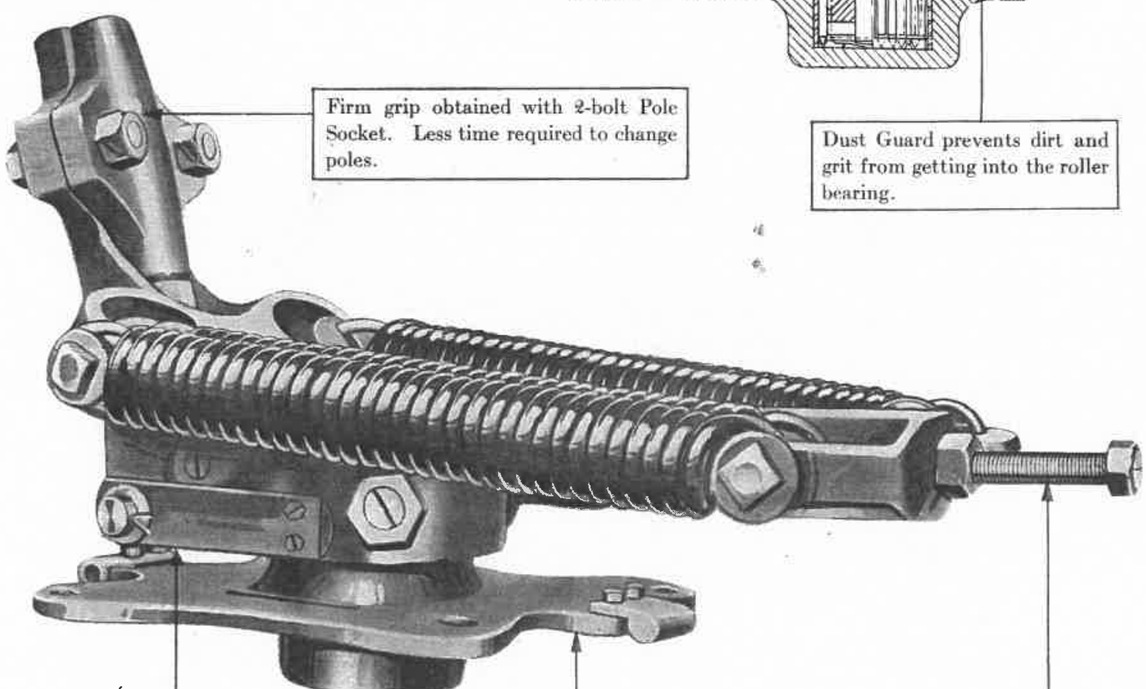
Spacious Leak-proof Oil Reservoir affords ample lubrication.

Hardened Steel Pin and Bushing minimize wear.



Firm grip obtained with 2-bolt Pole Socket. Less time required to change poles.

Dust Guard prevents dirt and grit from getting into the roller bearing.



Shunt carries the current without heating mechanical parts.

Heavy Casting for mounting base.

Adjusting Screw permits one adjustment for all springs.

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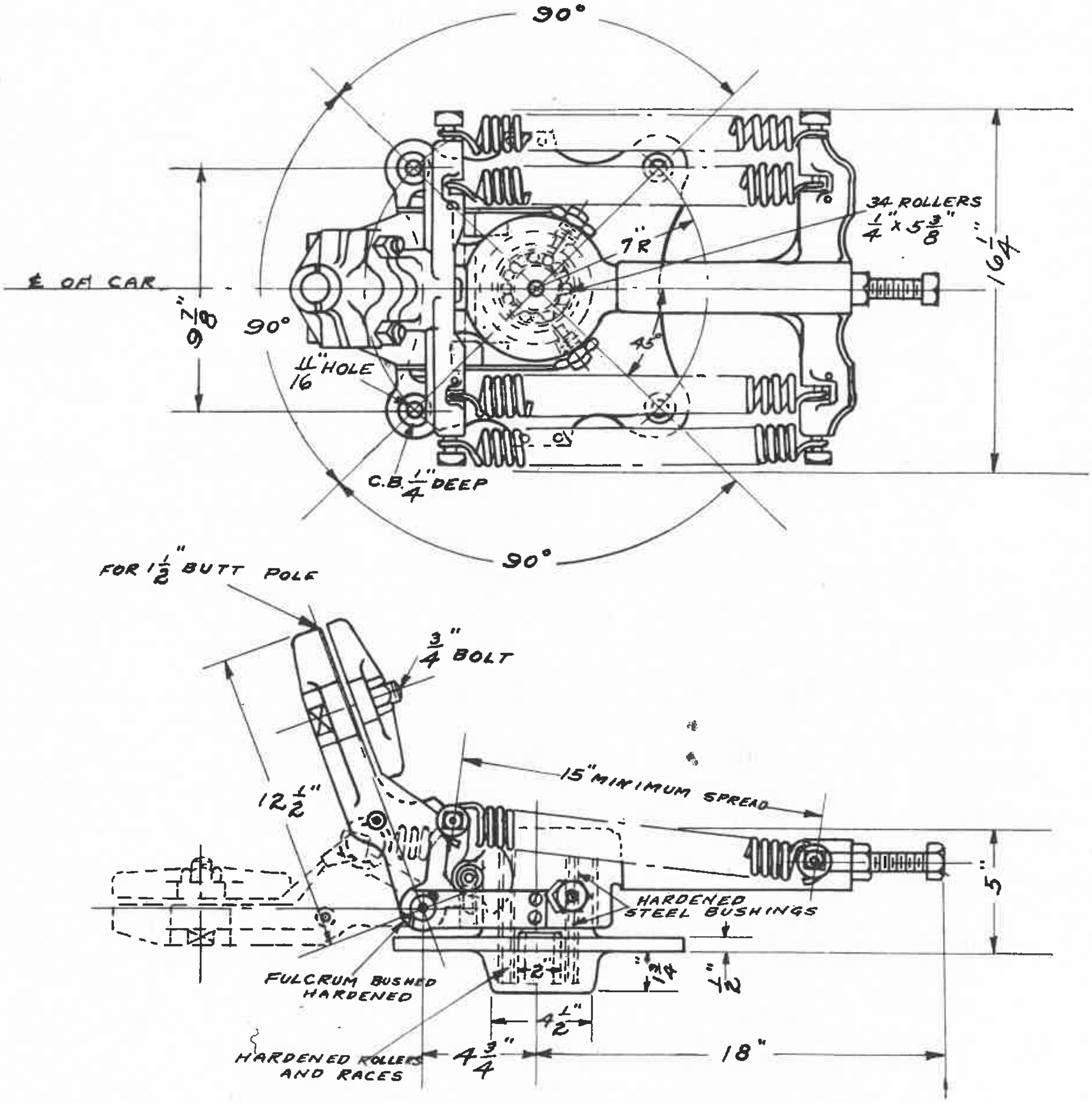
Dimensions US-13-E Trolley Base



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